

Oil & gas

Diaphragms enhance gas production

Horizontal drilling and hydraulic fracturing technologies grant access to natural gas encased in shale formations. However, this ingenious technological accomplishment is just the beginning to overcoming challenges associated with a shale well's 20 plus year life expectancy. New diaphragm pump technology is providing solutions to the harsh

Over the past decade, production of natural gas from shale formations has exploded, sparking a revitalization of the natural gas industry, and creating an industry where none previously existed. Who would have imagined the first well drilled in the Barnett Shale formation (near Fort Worth, Texas, USA) in 1981 by Mitchell Energy would lead to a transformation of the energy industry? After almost 20 years of effort, Mitchell Energy created the key to accessing low-cost, clean-burning, abundant energy from numerous and expansive global shale formations.

Technology pioneered by Mitchell Energy led to the discovery and development of gas fields in several states within the United States; including Texas, Pennsylvania, West Virginia, Ohio, Arkansas, Louisiana, Colorado, Wyoming and others. Additional large shale discoveries are being reported in many areas of the world, including Canada, Central America, Europe, Asia and Australia. Recently, Mexico announced it cancelled construction plans for 10 nuclear power plants in lieu of a new fleet of power generators powered by shale gas. And, China reported discoveries of major shale gas reserves in its western Sichuan region in at least 20 locations.

Radical advances in technology allow gas producers to extract a much greater percent of this clean-burning fuel from shale formations. Horizontal drilling and hydraulic fracturing

combine to grant economically access to this low cost, abundant, previously off limits, energy source.

Chemical Injection

Unlocking shale formations through horizontal drilling and hydraulic fracturing initiates the gas recovery process from producing zones deep beneath the surface; a process that often results in more than 20 years of production from a single well. During the production years, gas operators face additional significant

challenges to provide low cost energy to the world's population. Water and sand entering the well bore, corrosion of steel piping and harsh environmental conditions constantly work against the efforts of those striving to reclaim natural gas.

A resourceful industry soon discovered introducing specific chemicals into the contained well bore counteracted many of the detrimental effects of the harsh environment. Anti-corrosion inhibitors enhance the life of the steel tubing used to conduct the gas stream from the underground reservoir to the surface. Surfactants break the surface tension of water that enters the well bore, effectively reducing the water column pressure on the gas moving toward the surface. With reduced downward pressure exerting by the water column, more gas is extracted from the formation. In cold weather environments, methanol is often used to lower the freezing point of liquid moving through surface transportation piping.

Introducing production-enhancing chemicals into the well is most commonly accomplished with a pump at the surface. The pump's primary purpose is to consistently inject pre-set volume of chemicals into the well, without discharging harmful gases into the environment. Many may view the large number of variables in a well preclude the necessity for injected chemical volumes to be consistent. However, prudent operators know a consistent, repeatable volume of chemical



Figure 1. The iChem Solar Chemical Injection System.

injected into the well enables a predictable outcome – including the monthly usage, and thus cost, of the chemicals injected, corrosion rate of down-hole steel tubing and in some cases, even the volume of gas produced.

Equipment reliability and remote monitoring capabilities are additional key requirements of chemical injection pumps located at remote gas well locations. Pumps requiring frequent maintenance create unpredictable down-hole outcomes due to pump failures. Additional costs are incurred as skilled technicians are contacted to diagnose and resolve the pump problem.

Remote monitoring serves as 'eyes on the ground' for busy gas well operators. Traditional once-per-day pump operational knowledge is augmented by the pump controller's ability to contact the operator when an anomaly occurs. Gas well operators benefit on many levels through reducing the time between actual problem occurrence and detection at remote well sites.

Need for a better pump

To function at maximum efficiency, a chemical injection system must employ a reliable chemical pump that can inject chemicals into the reservoir both properly and consistently. Today, many systems utilise chemical pumps that do not deliver the desired results. Root causes include pump seal failure and chemical leakage, as well as pressure fluctuations within the well that affect the pump's dosing rates.

At present, no one pump can accommodate every different well configuration and do so cost effectively. As a result, many different types of gas- and solar-powered pumps are now used in dosing applications. Many of the current pumps are pneumatically driven piston pumps or plunger pumps. Despite their widespread usage, they are known to cause significant problems for many gas producing companies.

Indeed, although low-cost, comparatively-simple-to-operate gas-powered pneumatic pumps are popular among gas producers, they are now being phased out due to pending government environmental emission regulations. These regulations have been brought on by the fact that gas-powered pumps vent natural gas, or CO₂, into the air with each cycle. A typical gas-powered pump emits from 250 to 650 standard cubic feet per day (SCFD) of dry gas into the atmosphere. Escaping CO₂ and/or natural gas is dangerous to the environment and can be harmful to personnel working around the well.



Figure 2. The iChem Solar Chemical Injection System installed at a well-head site.

Gas-powered pumps often experience uneven performance in their principal function: delivering proper and consistent doses of a given chemical. Compared to other pumps, the injection rates of gas-powered pumps vary greatly due to pressure fluctuations in the gas supply required to power them. Chemical dosing is, thus, often inconsistent and inaccurate, necessitating producers to regularly dispatch service personnel to the well to check dosing rates. The bottom line is, companies must pay out more just to ensure the pumps are working and are doing what they are supposed to do.

Downtime is a real issue with gas-powered piston pumps. Seal failure and leakage of chemicals into the environment through the piston seals is typically the root cause of the problem. Some pumps, in fact, have more than 10 seals that are potential points of leakage.

With gas-powered pumps being phased out, many gas producers have begun utilising solar-powered pumps, most of which feature, almost exclusively, a reciprocating piston pump design with a cycle timer to control the pump. This design comes with many dynamic seals, such as stationary O-ring or V-packing, which tightens around the reciprocating rod to prevent fluid from slipping past the rod. This creates wear points, such as when the rotating eccentric cam rubs against the rod. The faster the rpm setting on a reciprocating piston pump, the faster these parts wear and require replacement. As dynamic seals wear, they become loose, causing chemicals to leak into the environment. To prevent this from happening, these parts need to be serviced (tightened) at regular intervals. One note of caution: if over-tightening occurs, the dynamic seals can grip the rod too

hard and cause more stress on the motor and drain the battery more quickly. This possibility requires gas producers to regularly dispatch service personnel to the well.

There is still another issue. Solar-powered reciprocating piston pumps have a tendency to draw a large amount of solar power in order to be used.

When this occurs, the flow-to-power ratio becomes very low. Also, many of these solar pumps do not have remote monitoring capabilities. The ones that do have remote capability – which is essential for monitoring well operations – are very costly compared to the price of a typical solar-powered pump. Remote monitoring gives operators the flexibility to monitor well performance without having to spend time and money on 'check-in' well visits.

The diaphragm pump solution

With gas-powered pumps on their way out, and many solar-powered pumps not living up to expectations, gas producers are in need of a new and innovative solar chemical injection system that incorporates a different type of pumping technology. Increasingly, they have been turning to a solar chemical injection system that features diaphragm pumping technology.

Diaphragm pumps are highly durable and resistant to various chemicals. Featuring few moving parts and no dynamic seals, diaphragm pumps are more reliable and easier to maintain than gas-powered and solar-powered pumps. The diaphragm completely separates the chemical side from the oil side. Regardless of the type of chemicals to be injected, seal materials do not require



Figure 3. The iChem eliminates chemical leaks, offers simple calibration, reduces operator time at well sites and increases production while reducing chemical expenses.



Figure 4. The iChem Solar Chemical Injection System provides accurate injection rates at well pressures up to 1,200 psi.

change-out. On the oil side, there are no O-rings in the pressurising piston sleeve, which means less wear on the piston rod.

Diaphragm pumps also feature a stainless steel head and check valves, and a Teflon® coated diaphragm to protect against corrosion. This robust design helps prevent chemical leaks, while enhancing performance and uptime. It also reduces the cost of maintenance. Diaphragm pumps are also hydraulically balanced to reduce stress and increase pump life.

One of the major concerns voiced by gas and oil producers relative to their pumping equipment is the degree of inconsistency in chemical injection rates. Since chemical injection recovery methods are usually limited by the cost of the chemicals, improving the efficiency in which these chemicals are injected is a requirement. Diaphragm pumps address this concern by dosing chemicals with extreme accuracy.

iChem chemical injection system

When speaking specifically about chemical injection systems that utilise diaphragm pumping technology, Ferguson Beauregard recently launched a joint engineering effort with two of its sister companies, Blackmer and Neptune Chemical Pump Company, to create the iChem Solar Chemical Injection Pump System (iChem). Relying on the resources and expertise of some of the most trusted names in the energy and chemical dosing industries, the iChem solves many of the problems experienced with other chemical injection systems, thereby streamlining productivity and enhancing profitability.

The iChem is based on the Neptune diaphragm pump technology that has been used in industrial chemical dosing for years. The iChem diaphragm pump features a brushless motor, paired with

a digital controller for precise, accurate injection rates. Over the pressure range of 300 to 1,200 psi, tests show that the iChem has a smaller deviation of injection rate within a 95% confidence interval. The result: over-injection of chemicals and corresponding waste rates are lowered significantly. At 1,200 psi, other solar chemical injection pumps can vary their injection rate as much as 2.8%. By comparison, the iChem's injection rate varies only as much as 0.9%. iChem's reliability means fewer personnel trips to the well to ensure accurate injection rates.

Injection rates on iChem diaphragm pumps are easily adjustable to ranges from 0 to 45 gallons per day. Gone are the days of the dip-switch timer. iChem controls are digital, which allow users to cycle the pump for exact amounts of time to ensure highly accurate daily injection rates. An onboard calculation routine enables users to run a common rate test, record the results of that test, and plug the values into the controls, along with the desired injection rate. The controls automatically set the desired cycle times. They can also be configured to allow for remote monitoring via a mobile phone at a substantially lower cost compared to other commercially available remote monitoring solutions.

The iChem chemical injection system offers numerous benefits and advancements over and above what other systems offer, notably, it:

- Is engineered to run independent of the well, using solar power stored in a 100 Ah, 12 V DC battery
- Consumes less energy compared to other leading solar chemical injection systems
- Is environmentally friendly – emitting no atmospheric gases
- Dispenses accurate, safe, energy-efficient doses, helping to lower chemical consumption and corresponding costs. ■

Contact

Duncan McFarland
Product Development Engineer
Ferguson Beauregard
Tel: +1 903 561-4851
Email: dmcfarland@fbdover.com

Sudip Sarker
R&D Manager
Neptune Chemical Pump Co.
Tel: +1 215 699-0370
Email: sudip.sarker@neptune1.com
www.iChemSolarPump.com